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ABSTRACT

The study compared the effectiveness of two commonly used questioning sequences with four preschool developmentally delayed male children, aged 3 to 5 years, and their four adult trainers. The Full Model to Open Question sequence began with presenting the child with a model of the correct answer and then proceeded to increasingly less restricted choices until the open ended request ("Tell me about this"). The Open Question to Full Model sequence begins with the open question and proceeds through the sequence in reverse order until the child responds correctly. Each S received each training sequence for two sets of responses. Results indicated that the Full Model to Open Question strategy required fewer training sessions than the Open Question to Full Model strategy with all four Ss and trainers. Although both strategies were successful in teaching the target responses, under the Full Model to Open Question condition, each S appeared to evidence a "learning to learn" phenomenon with fewer sessions necessary for the second set of responses taught. (DB)

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TEACHER USE OF DIAGNOSTIC QUESTIONING AND MODELING IN LANGUAGE DEVELOPMENT

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Teacher Use of Diagnostic Questioning and Modeling in Language Development

Most educators are well aware that research on teacher questioning behavior, long described as a predominant form of teacher behavior present at all levels of instruction (Adams, 1964; Aschner, 1961; Gall, 1970), has produced conflicting and inconclusive results (Odey & Humphreys, 1974; Rosenshine & Fuerst, 1971). Typically investigations of teacher questioning have focused on extremely general and indirect use of questioning in the instructional process (Borg, Kelley, Langer, & Gall, 1970). Few studies have examined the direct and systematic application of questioning to evoke learning responses pursuant to the attainment of specific instructional objectives. Diagnostic questioning, a direct teaching strategy which employs a sequence of specific question types, has received some research attention. According to stowitschek and Hofmeister (1974) diagnostic questioning is intended to pinpoint and remediate sources of student error in academic work and may have significant value as a metholodogy for teaching various academic skills (Borg et al., 1970; Stowitschek & Armstrong-Iacino, 1978).

Diagnostic questioning approaches may also have substantial worth for teaching language and early concept learning in young handicapped children. Stowitschek and Armstrong-Iacino (1978) reported that their diagnostic questioning strategy not only increased computational skill of disabled learners, but problem solving and reasoning skills as well. While development of effective expressive language and communicative behavior is often measured by observable linguistic behaviors, it is a generally accepted corollary that a child's concept development, reasoning skills, and overall

cognitive development contribute to his linguistic development (Bowerman, 1974, 1978; McLean & Snyder-McLean, 1978; Slobin, 1973). Thus it follows that any strategy which improves overt performance and contributes to a child's ability to reason should be useful for facilitating language development. Diagnostic questioning, moreover, is more robust than some direct teaching strategies in that it can be readily applied in both structured and unstructured language learning contexts.

The purpose of the present study was to examine the effects of two commonly used questioning sequences, Full Model to Open Question and Open Question to Full Model, on the expressive language repertoires of handicapped preschool children. Both diagnostic questioning strategies consisted of sequences of preselected question types asked by the trainer in response to correct or incorrect answers of the child. The Full Model to Open Question sequence essentially paralleled the questioning series used by Stowitschek and Armstrong-Iacino (1978). The Open Question to Full Model sequence consisted of the same questions and models presented in reverse order.

METHOD

Subjects and Setting

Four preschool male children, aged 3-5 years, enrolled at the Kennedy Center Experimental School at George Peabody College of Vanderbilt University served as subjects. Criteria for participation included: a) children who could imitate two to four word strings but seldom spontaneously labelled common objects, pictures or events, and b) children whose current level of language usage was one-two years developmentally delayed. Experimental

training sessions were conducted in small observation rooms adjacent to each subject's classroom. Four graduate students in special education served as trainers in partial fulfillment of a practicum requirement.

Materials

Stimulus cards depicting single objects or organisms, human actions and interactions, and human emotions were selected from commercially available picture card sets (e.g., Peabody Language Development Kit, 1965) and supplemented with teacher-made picture cards or pictures cut from magazines.

Target Responses

Responses to be trained were determined for each child based on language he demonstrated. Subject 3, for example, was just beginning to spontaneously emit two word utterances, but could imitate them adequately. Therefore, Subject 3's target responses were set at two word combinations. Other subjects were required to emit full sentences of varying complexity.

Each subject was trained two sets of responses to each of two sets of stimulus cards. Each set of responses for any subject was consistent with regard to form. For instance, Subject 4 learned to say, "The boy is swinging," All other responses in that set had the same grammatical structure. The second set of responses was always an expansion upon those in the first set, e.g., "The little boy is swinging very high."

Procedure

Individual probe (baseline) and training (intervention) sessions were scheduled daily, Monday through Thursday and lasted 5 to 12 minutes. Following baseline each child received training twice under each of the conditions:

1) An Open Question to Full Model (OQ-FM), and 2) A Full Model to Open Question (FM-OQ) condition.

Probe sessions. During each probe session the trainer presented two sets of 8 to 10 stimulus cards, one card at a time and requested, "Tell me about this." No feedback was given concerning the correctness of subject responses; however, statements such as "okay" and "That's nice loud talking," were provided intermittently.

Training sessions. During each training session a specific series of diagnostic questions were presented and verbal praise given for each correct response. Each of the two diagnostic questioning strategies was employed twice with each subject. Subjects were trained using one procedure at a time.

During training with each of the questioning strategies, a stimulus card was presented and an initial question asked. If a correct response followed, the child was praised and the next card presented. If an error occurred, the trainer proceeded to the next level of question asking in the diagnostic series.

If a child erred on the first question during the Open Question to Full Model (OQ-FM) procedure, a series of progressively more restricted question types was asked. Each question in the OQ-FM series provided additional cues to the subject regarding the desired response. In essence guidance toward a correct response was accomplished by limiting the response alternatives available to the subject and by including more and more direct prompts. As soon as the subject responded correctly at any level of questioning he was praised and the Open Question was presented a final time. The OQ-FM strategy

included these question types presented to the subject in the following order:

A. Open Question (OQ). This type of question (or statement) was intended to gain a two word or short sentence response. It required the student to produce a response, rather than imitate a model or choose from available alternatives.

Example - Teacher: "Tell me about this." (Teacher holds up a picture of a cat. The correct response is "It's a cat.")

Student: "It's a dog."

B. Multiple-Choice Question (MC). This type of question presented alternative responses which included the correct response.

Example - Teacher: "Is it a cat or is it a cow?"

Student: "It's a cow."

C. Restricted-Alternative Question (RA). This type of question eliminated the alternative incorrect response without presenting a complete model of the correct response.

Example - Teacher: "It's not a cow. What is it?" (Not is emphasized.)

Student: "A cat."

D. Full Model (FM). This was actually not a question but a statement followed by a direct model intended to gain a correct imitative response. The teacher requested the student to imitate and model the response.

Example - Teacher: "Say, 'It's a cat.'"

Student: "It's a cat."

Teacher: "Yes, it's a cat. Very good." "Tell me about this."

Student: "It's a cat."

Teacher: "Very good!"

The Full Model (FM) step was reduced further, if the subject did not successfully imitate the full model. In such cases, a partial model (PM) or a limited number of the words in the target response were provided, e.g., "Say, 'It's a'." After the child said these few words, the full sentence was again modeled, e.g., "Say, 'It's a dog.'" The trainer used her own discretion to select which words to model when giving a partial model. All questions were asked a maximum of two times before the next question was presented. Subjects who did not respond correctly by the end of the questioning sequence were told, "That's a good try," or praised for cooperative behavior.

Similarly, the Full Model to Open Question (FM-OQ) strategy was applied in the same manner as the Open Question to Full Model (OQ-FM) strategy, only the question types were presented in reverse order.

Observation Procedures and Data Collection

Data on trainer questioning and child behavior were collected during probe and training sessions. A data sheet adopted from the one used by Stowitschek and Armstrong-Iacino (1978) allowed for continuous recording of trainer and child behavior, thus, affording a sequential account of all behaviors emitted during each trial. Figure 1 presents a sample of one teaching trial. This sample trial is typical of the sequence of behaviors

that occurred during the Open Question to Full Model diagnostic questioning sequence. Basically, a matrix was used to collect data on each trial. The horizontal axis of the matrix was divided into sections which indicated Question 1, Question 2, Question 3 and so on. The section for each question is further divided into the three categories of Stimulus (S) - Response (R) -Consequence (C). The vertical axis of the matrix lists the types of stimulus questions that might be applied in any given trial. The trainer began recording in the left column and placed a check mark (✓) next to the question type that she asked first (e.g., Open Question (OQ), Multiple Choice (MC), Restricted Alternative (RA), Full Model (FM), Partial Model (PM), or Other (O).) In this case the trainer checked OQ in the first S-R-C question section. A plus (+) or minus (-) sign was used to indicate a correct or incorrect child response. If the child did not respond within 5 seconds, a minus was recorded. At the far right the trainer could also write comments. In this instance the trainer noted that the minus sign represented "no response" by the child. If the teacher consequated the child, a plus was used to indicate praise or positive feedback and a minus sign denoted criticism or negative feedback. An empty space such as the one under Question 1, C, indicated that the trainer did not consequate the child, but moved to the next level of question asking, i.e., Multiple Choice Question. Each time a new question type was presented, the trainer moved down one row before taking data on the S-R-C sequence. If the trainer errored at any level of the S-R-C sequence she circled that cell. An error was recorded during the third question, i.e., Restricted Alternative Question. The trainer said, "It's not a dog," but forgot to ask, "What is it?" Therefore the trainer circled the check mark in that cell. Additions, omissions or substitutions were considered errors.

By glancing at an entire trial it was possible to see if the sequence of questions was correctly presented by the teacher. By looking at Figure 1 it can be seen that a correct Open Question to Full Model sequence leads to a row by row descending pattern. A row by row ascending pattern accompanies correct implementation of the Full Model to Open Question sequence.

Experimental Design

A within-subject across behavior multiple baseline design was employed (Baer, Wolfe, & Risley, 1968). Replication of effect was demonstrated across four subjects. A cross-over design (Herson & Barlow, 1976) was used with Subjects 1 and 2 to control for order of training effect. Subject 1 received training interventions in this order: FM-OQ, OQ-FM, FM-OQ and OQ-FM. Subject 2's training sequence occurred in the opposite order beginning with OQ-FM. The training conditions for Subjects 3 and 4 were varied randomly.

Baseline. Five probe sessions (Open Questions only) were conducted with each subject on each set of stimulus cards. The five sessions were held across a two week period.

Intervention: Open Question to Full Model (OQ-FM). The OQ-FM strategy was used to train two sets of responses to each subject. The OQ-FM condition was terminated and another condition begun when a subject reached criterion. The criterion for phase change was set at an average of 90% correct across three consecutive training sessions.

Intervention: Full Model to Open Question (FM-OQ). As with the OQ-FM condition, the FM-OQ strategy was employed to train each subject two sets of responses. Each subject was taught a set of responses to criterion and a phase change was instituted.

As mentioned specific responses trained under either condition were expanded and retrained in the second instatement of that condition. For example, a correct response in Set 1a might be "bird singing," while the correct response in Set 1b might be "It's a bird singing."

RESULTS

Reliability

Interobserver observations of trainer and child behavior were conducted an average of .25 sessions with a minimum of one reliability check per condition. Interobserver agreement on teacher behavior was calculated by dividing the number of agreements by the number of agreements plus disagreements. Each trainer question in the diagnostic questioning series being presented, the order of entire sequence of questions, and trainer verbal feedback were considered behavior categories and counted as occurrence agreements or disagreements. Interrater agreement on trainer behavior ranged from 82% to 100% with a mean agreement of 96.5%. Interobserver agreement on subject responses was calculated using the same formula. Plus or minus scores for each S-R-C component of each question was scored as an agreement or disagreement. Interobserver agreement on subject behavior ranged from 79% to 100% with an average 98.5% agreement.

Trainer Performance

Analysis of the trainer's use of questions revealed that all four trainers followed the two questioning sequences with a very low frequency of errors. Trainer errors that did occur were errors pertaining to the construction of questions and not to the sequence of questions. For instance,

a trainer might say, "Is it a dog or cat?", instead of "Is it a dog or is it a cat?" At no time did trainer errors in question asking exceed three per session. Over .95 of trainer errors occurred during the first days of training. Few errors occurred during the second condition of either questioning strategy. No errors were observed to occur with regard to noncontingent use of praise. No trainer errors were recorded during the baseline sessions. The majority of trainer errors observed (70%) occurred during the OQ-FM questioning strategy.

Child Performance

Figures 2-5 present the percent of correct responses per session of Subjects 1-4, respectively, across baseline and two intervention conditions of OQ-FM and two intervention conditions of FM-OQ. Two sets of stimulus cards and four sets of responses were trained per subject. Each subject's initial training on a set of cards is depicted in Figures 2-5 with solid circles and solid triangles. Expanded responses are designated with open circles and open triangles.

Figures 2-5 show that each subject required fewer days to reach criterion when trained under the FM-OQ strategy than under the OQ-FM questioning sequence. Subject 1 required 12 and 17 days under the first and second OQ-FM conditions, respectively, compared to 16 and 6 days under FM-OQ, representing a total of 7 fewer days under FM-OQ. Subject 2 learned the target responses in 7 and 23 days under OQ-FM compared to 7 and 3 under FM-OQ, a difference of 20 days. Subjects 3 and 4 evidenced a similar pattern of correct responding; they required 6 and 15 total fewer training days, respectively, under the FM-OQ than the OQ-FM strategy.

The performance of the four subjects during the second FM-OQ training strategy was consistently better than the first FM-OQ condition. Subject 1 learned the second set of responses in 6 days, a reduction of 10 days from the first set. Subject 2 reached criterion on the first set in 7 days and the second in 3 days. Subject 3 learned the target responses in 9 and 5 days; Subject 4 in 4 and 3 days. On the average five fewer training sessions were required to teach expanded responses than the initial responses under the FM-OQ condition. No consistent relation between learning of first and second response sets was observed under the OQ-FM questioning strategy. Subjects 1 and 2, for instance, required a greater number of days to learn the first set of responses.

Another significant difference was that on the average 49% of all child responses during the OQ-FM condition were correct (and subsequently praised) compared to 83% correct responding during the FM-OQ condition.

In the FM-OQ condition the subjects often were not exposed to two question types, namely Multiple Choice and Restricted Alternative Questions during many trials because they responded correctly immediately following the full model. Therefore all subjects were probed on MC-RA questions following one training phase of each questioning strategy. Post-testing revealed that subjects responded to Multiple Choice and Restricted Alternative Questions correctly at a level above criterion, i.e., an average of 90% correct.

DISCUSSION

Of the available research on teacher questioning behavior (e.g., Adams, 1964; Ascher, 1961; Gall, 1970), there is little evidence to draw firm conclusions regarding the relationship between teacher questioning and student

performance. How should teachers construct questions? What effect do specific sequences of questions have on learner performance? Can questions or question sequences be employed to lead students efficiently to desired responses? Such questions combined with teacher trainers and educational researchers strong recommendations for investigation and validation of common teaching strategies (Gable, 1977; Shores, Cegelka & Nelson, 1973) led to the current study. The effects of two diagnostic questioning strategies, strategies that call for prespecified question asking behavior on the part of the teacher were studied. One strategy, an Open Question to Full Model (OQ-FM) sequence, was similar in content and sequence to the strategy Stowitschek and Armstrong-Iacino (1978) found to be effective for teaching students with conceptual difficulties and computational deficiencies. The other strategy, Full Model to Open Question (FM-OQ), employed the same question types in reverse order. Results indicated that the FM-OQ strategy was superior in several respects to the OQ-FM strategy for training specific expressive language responses to preschool children with atypical or delayed language. While the OQ-FM sequence which provided an increasing number of cues and structure to guide the student's formulation of his response was successful, the FM-OQ sequence which provided immediate and direct assistance to the child was the more efficient strategy. The latter required substantially fewer training sessions than the OQ-FM sequence. (A total of 53 sessions were used under FM-OQ compared to 101 sessions under OQ-FM.)

Under the FM-OQ conditions each subject appeared to evidence a "learning to learn" phenomenon or as Garcia and DeHaven (1974) and Hendrickson (1977) have noted, more efficient learning on subsequently trained response sets. The responses taught in the second FM-OQ condition were more complex, but

were acquired in considerably fewer sessions than the initial responses. Further, high levels of correct responding were evidenced earlier during training in the FM-OQ conditions than during OQ-FM conditions. That is, learning curves under FM-OQ generally showed relatively immediate and significant accelerations compared to slower and more variable curves during the OQ-FM. These observations lend credence to the notion that the subjects "caught on" to the FM-OQ strategy rapidly and learned how to use the strategy productively. Any technology of teaching which promotes an individual's ability to grasp the intent of the speaker and adapt his or her behavior to accommodate that intent should be viewed with careful interest by special educators. The results of this study suggested that the FM-OQ strategy may be particularly useful for teaching children to simultaneously learn new linguistic structures and new content, provided the initial selection of target behaviors is developmentally appropriate.

Across all training phases the subjects averaged 49% correct responding under the OQ-FM strategy and 83% correct responding under the FM-OQ strategy. Teaching strategies such as the FM-OQ which promote high levels of correct responding may be more desirable than strategies which lead to trial and error learning. Not only was the time required to learn specified behaviors reduced under the FM-OQ sequence, but as Hendrickson, Roberts, and Shores (1978) found, the level of positive feedback from the instructor (teacher or parent) was increased. An increase in positive consequation should make the learning/teaching situation more enjoyable for teacher and student. Trainer opinion of the two questioning strategies suggested that this may indeed have been the case. All trainers preferred the FM-OQ sequence and noted that since the participating children had limited language, i.e.,

few alternative responses in their repertoires, direct, immediate assistance was most desirable. The FM-OQ strategy allowed trainers to intervene immediately and bring the child's response to a level that could be positively consequated. On the other hand, if the subjects "failed" at one level of question asking in OQ-FM sequence, they often acted perplexed or defeated when the next question was asked, a response that was punishing to the trainers. Furthermore, the next question in the OQ-FM sequence frequently did not provide sufficient cues for the subjects to enable them to make a correct response. Subsequently, there was a relatively long chain of teacher-child behavior with little or no positive consequation, particularly during the first days of training.

In discussing the greater efficacy of the FM-OQ strategy it should be noted that more trainer errors occurred under the OQ-FM strategy and that these errors may have confounded the results obtained. The possibility that child errors were a consequence of trainer behavior during the delivery of the OQ-FM procedure was examined. Inspection of the data showed that child errors were not unusually high following a trainer deviation. More importantly, however, is the fact that the total frequency of errors was extremely low in both strategies and trainer errors could not account for the difference between the number of subject errors under the two diagnostic questioning conditions. In addition during the second condition of each procedure, FM-OQ always resulted in more efficient learning, although no trainer errors were observed during training with either strategy.

A mild level of generalized responding was noted subsequent to training with both diagnostic questioning strategies. Once the subjects completed

training all were able to answer each question type correctly a majority of the time when it was presented independently. It would be difficult to conclude that children exposed only to the FM-OQ sequence would respond as well to Multiple Choice (MC) and Restricted Alternative (RA) as subjects who were trained under both FM-OQ and OQ-FM. These data do suggest, however, that in spite of minimal or no exposure to some question types (MC and RA during FM-OQ) handicapped preschoolers can learn to respond correctly to a variety of question types. One might hypothesize that young children could be taught language responses appropriate to a number of question types with minimal direct training, if questioning strategies were applied consistently in some previously designated sequence(s). It would seem feasible that various question types could be embedded in diagnostic questioning sequences so that optimally timed (though low frequency) direct training of these questions would result in high levels of generalized responding. Clearly, researchers, teachers, parents and all persons involved in direct service to young handicapped learners could contribute immensely to addressing issues related to verification of the effects of diagnostic questioning sequences if simple data collection and reliable intervention procedures were implemented.

There was some evidence to suggest that the FM-OQ strategy may be beneficial for teaching higher level skills than those trained in the present study. The subjects herein had no history of spontaneous usage of the specific target behaviors. Thus, a strategy such as OQ-FM which provided increasing cues was necessary, but not sufficient for rapid learning. On the other hand, for students with all response components in their repertoire but are not under appropriate stimulus control, the FM-OQ

strategy may be the more useful for setting the occasion for rapid, correct responding than the OQ-FM procedure. Even subjects with behavioral repertoires that indicate they are "ready" and likely to gain from learning complex responses might learn more efficiently in situations where initially strong support is provided from the teacher. Conversely, subjects who have spontaneously displayed examplars of the desired behaviors might benefit more from a strategy that provides minimal cues (the OQ-FM sequence). Such a strategy would give the student an opportunity to weigh alternatives, engage in divergent thinking, and/or "discover" a solution rather than simply wait for the answer to be modeled.

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TRIAL 1 Response: It's a cat.

	Question 1			Question 2			Question 3			Question 4			Question 5			Comments
	S	R	C	S	R	C	S	R	C	S	R	C	S	R	C	
OQ	✓	-														No response
MC				✓	-											Dog
RA							✓	-								N.R. Omission
FM										✓	+	+				Good Artic.
PM																Good Attending
O																

SAMPLE OPEN QUESTION TO FULL MODEL

Trainer (T): "Tell me about this."
Subject (S): No response within 5 seconds.
(T): "Is it a cat or is it a dog?"
(S): "Dog."
(T): "It's not a dog. (What is it?)"
(S): No response
(T): "It's a cat. What is it?"
(S): "It's a cat."
(T): "Yes, good talking! It's a cat!"

FIGURE CAPTIONS

FIGURE 1. Sample Data Sheet with Teacher and Child Behaviors during an Open Question to Full Model Question Sequence.

FIGURE 2. Percent of Subject 1's Correct Responses during Baseline and Two Intervention Conditions of Full Model to Open Question (FM-OQ) and Open Question to Full Model (OQ-FM).

FIGURE 3. Percent of Subject 2's Correct Responses during Baseline and Two Intervention Conditions of Full Model to Open Question (FM-OQ) and Open Question to Full Model (OQ-FM).

FIGURE 4. Percent of Subject 3's Correct Responses during Baseline and Two Intervention Conditions of Full Model to Open Question (FM-OQ) and Open Question to Full Model (OQ-FM).

FIGURE 5. Percent of Subject 4's Correct Responses during Baseline and Two Intervention Conditions of Full Model to Open Question (FM-OQ) and Open Question to Full Model (OQ-FM).